Technical Memorandum
Vapor Control System
Upgrade Design

Hartford, Illinois

Clayton Project No. 15-03095.13.002
May 6, 2004

Prepared for:
THE HARTFORD WORKING GROUP
Hartford, Illinois

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Clayton
GROUP SERVICES

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1.0 INTRODUCTION

Previous performance testing conducted on the existing Vapor Control System (VCS) has identified that the existing Vapor Control Borings (VCBs), including well screen, sand pack, filter sock, have become plugged from an accumulation of hydrocarbon residue. On behalf of the Hartford Working Group (HWG), Clayton Group Services, Inc. has prepared this Vapor Control System (VCS) Upgrade Design Technical Memorandum to provide design details related to the planned upgrade of the existing system. The upgrade involves only the replacement of the current system components and not the expansion of the system with the addition of new wells. The purpose of the system is to extract vapors from the unsaturated zone where residual hydrocarbons are present and from the top of the free-phase hydrocarbon floating on the groundwater beneath the Village of Hartford.

The upgrade design and implementation are being conducted in accordance with the work plan outlined in the *Detonation Flame Arrestor Element Replacement & Soil Vapor Extraction Test Report* submitted to the Agencies on March 8, 2004 and approved on April 8, 2004. This technical memorandum addresses issues identified in the April 8, 2004 approval letter.

The design basis for the VCS upgrade is presented in Section 2.0. The layout of the upgraded VCS is discussed in Section 3.0. The operation of the upgraded VCS is discussed in Section 4.0. A discussion of the construction schedule for the VCS upgrade is presented in Section 5.0.

2.0 VAPOR CONTROL SYSTEM DESIGN BASIS

The following sections describe the methods and calculations used to design the Vapor Control System upgrade.

The current VCS comprises 12 vapor control borings (VCBs) situated in the northern portion of the Village of Hartford. These VCBs are connected via underground steel piping to a treatment compound located on Premcor's property east of the Village of Hartford. At the current treatment compound, the system consists of two vacuum blowers (arranged in parallel) discharging to an enclosed flare (TTU) for treatment.

Due to the age of the equipment and the expected increase in hydrocarbon loading on the thermal treatment system, it was decided to install new equipment as part of the VCS upgrade. This upgrade involves only the replacement of the current system components and not the expansion of the system with the addition of new wells.

This system is designed to extract vapors from the unsaturated zone where residual hydrocarbons are present and from the top of the free-phase hydrocarbon floating on the groundwater beneath the Village of Hartford. Soil vacuum extraction (SVE) is an established remediation technology commonly used to extract volatile compounds from unsaturated soil and remove volatile free-phase hydrocarbons floating on top of groundwater. During SVE, a vacuum is applied to an extraction well to lower the pressure near the well. Application of a vacuum at the extraction well induces an advective flow of soil vapors from regions of higher pressure to the extraction point. This process can enhance the volatilization of contaminants and promote the diffusion of sorbed contaminants into soil pores where they can be extracted along with soil vapors.

2.1 REPLACEMENT EXTRACTION WELLS

Previous performance testing conducted on the existing VCS has identified that the existing VCBs (well screen, sand pack, filter sock) have become plugged from an accumulation of hydrocarbon residue. Replacement of the VCBs with new VCBs was determined more cost-effective and efficient compared to rehabilitation of the existing VCBs.

To tie-in the new extraction wells with the VCS piping network, the new extraction wells will be connected to the existing VCB wells. The new wells will be installed within approximately 10 feet of the existing VCBs providing subsurface utilities do not prohibit such a location.

Following the installation of the new extraction wells, each existing VCB will be unearthed to allow for the connection of the new well to the top of the existing VCB. For this to occur, each existing VCB will be isolated from the VCS piping network/TTU by replacing the control valves (within the control vaults) with blind flanges. The VCS will be shut down during the blind flange installation and restarted once the VCBs have been isolated. It is anticipated that up to five VCBs may be isolated at one time to facilitate the construction schedule and limit VCS downtime. The new extraction wells will be joined to the top of the existing VCBs to connect the new wells to the existing VCS piping network. The connection piping will include a flow control valve that will be housed (with the well itself) within a traffic-rated vault box. During construction of the connection piping, the riser pipe for each VCB will be extended to the surface where it will be terminated in a flush-mounted well cover. This access point will provide for future grouting of the VCBs once the new wells have been installed and the new extraction/treatment units are operational. A detailed cross-sectional drawing showing the existing VCBs and the new extraction well connection piping network is provided in Figure 2-1.

Once the connections are complete at each new well location, the isolation flanges will be removed, and the flow control valves will be reinstalled. The new extraction wells will remain isolated from the VCS piping network by keeping the new flow control valves closed at each of the new wells. The valve to the new wells will be opened and the existing VCB grouted (below the piping connect point) only when the new extraction/treatment system is operational.

The new extraction wells will be constructed of 4-inch inside-diameter (ID) polyvinyl chloride (PVC) well screen and riser pipe. The screen will consist of 20 feet of 0.020-inch slotted openings. The screen will be installed to intersect the vadose zone soils from approximately 7 to 27 feet below surface grade (bsg). The well screens will be situated to intersect the North Olive Stratum, the Rand Stratum, and the EPA/Main sand unit, if present. The new extraction wells will penetrate the EPA/Main sand only where this unit is deemed unconfined. Where the EPA/Main sand unit is deemed confined, the recovery wells will terminate approximately 2 to 3 feet above the EPA/Main sand to prevent penetration of the well screen into the free-phase hydrocarbon/water table. The selected preliminary screen intervals (with the corresponding stratum each well screen interval will intersect) and the expected depth to water are provided for each extraction well location in Table 2-1. As has occurred in the past, it is possible that some of the new extraction wells may have reduced effectiveness during high groundwater conditions.

The new extraction wells will be drilled using hollow stem augers. The soils will be continually sampled and logged/classified using Clayton's Standard Operating Procedure (SOP) No. 120 for "Borehole Logging and Material Classification." In addition, Clayton's SOP No. 500 for "Equipment Decontamination" will be followed to prevent cross-contamination between borehole locations. These SOPs were previously submitted to the USEPA/Illinois EPA within the *Investigation Plan to Define the Extent of Free Phase and Dissolved Hydrocarbon in the Village of Hartford, Illinois* dated January 7, 2004.

2.2 VACUUM MONITORING PROBES

Prior to installation of the new extraction wells, a series of vacuum monitoring points will be installed at select locations across the northern portion of the Village. Subsurface geologic information collected from the installation of these points will be used to further select the ultimate screen intervals for the new extraction wells. Soil samples may be collected from select monitoring point boreholes for grain size/texture analysis. This information may be used to further define the exact interval of the extraction well screens, especially where a confined EPA/Main sand is encountered. In this instance, a grain size/texture analysis may be performed on the soils immediately above the EPA/Main Sand. The information would provide pertinent data on how permeable the soils are above this unit and help determine where to ultimately terminate the well screen above the EPA/Main Sand.

The vacuum monitoring points will be used going forward to monitor the influence of each new extraction well and, therefore, the effectiveness of the system. As noted in comment number 5 of the Agency's April 8, 2004 approval letter, each monitoring point will consist of up to three monitoring probes to measure subsurface vacuum across the soil profile. The three subsurface lithologies to be monitored are the North Olive Stratum, the Rand Stratum, and the EPA/Main Sand unit. An individual monitoring probe will be installed (at each monitoring point) within each of these units, where present. The monitoring probes will be constructed of 0.75-inch ID PVC well screen and riser pipe. The screen will consist of one foot of 0.010-inch slotted openings situated to intersect the top (unsaturated) portions of each stratum. Where the EPA/Main Sand unit has been deemed to be confined, a 5-foot section of 0.010-inch slot PVC screen will be installed with the bottom 3 feet of this screen within the EPA/Main Sand. This will allow airflow monitoring above the EPA/Main Sand when confined (completely saturated) and will allow monitoring within the sand when not confined. Where the EPA/Main Sand is deemed unconfined, a one-foot section of 0.010-inch slotted screen will be installed at the top of this unit only. Figure 2-2 details the multi-point vacuum monitoring probe constructions for the "Confined" condition, and Figure 2-3 details the multi-point vacuum monitoring probe construction specifications for the "Unconfined" condition. The projected strata at each monitoring point location are further detailed in Table 2-2.

Like the new extraction wells, the multi-probe monitoring probes will be drilled using hollow stem augers. The installation of these monitoring points will follow the same SOPs (SOPs No. 120 and 500) as referenced for the new extraction well installation.

The multi-point vacuum monitoring points will be used to measure the vacuum distribution or radius of influence (ROI) of the new extraction wells. The corresponding vacuum levels will be measured using Magnehelic negative pressure gauges temporarily attached to the top of each monitoring probe with a quick-connect air lock fitting. The accuracy of the vacuum gauges is approximately ± 0.02 inches of water column (W.C.)

The vacuum response at each multi-point monitoring probe will be recorded to determine the vacuum distribution in the subsurface soil profile and the corresponding ROI under flow/vacuum conditions. The effective ROI is defined in the literature as the distance at which air is advectively drawn towards the extraction well at a rate that will effectively remove contaminants from the soil.

2.3 VACUUM BLOWERS

The results of the SVE pilot test on a new well installed near VCB-1 indicated optimum vacuum influence was achieved between 75 and 100 cubic feet per minute (cfm) at vacuums of between 40 and 90 inches of W.C. Extrapolating this information to all 12 existing VCBs, a total flow rate ranging from 900 to 1,200 cfm at approximately 100 inches of W.C. will be required for the system to operate at optimal conditions.

Two blowers will be installed to operate the VCS in its current configuration. Each blower will be capable of at least 750 cfm at a vacuum of 100 inches of W.C. The blowers will be arranged and operated in parallel to achieve the desired total flow range of between 900 and 1,200 cfm for all the wells. If one of the blowers requires maintenance, the second blower can continue to operate the system. Furthermore, this will allow for routine maintenance of the blowers without the requirement to shut down the system.

An integral water removal system will be included with each blower. The system will include a 240-gallon water knockout tank to remove moisture or water that may be entrained through the extraction wells. Each of the knockout tanks will be equipped with a float-activated discharge pump capable of removing any water separated before the blower and discharging this water to a temporary condensate storage tank for eventual treatment offsite.

Each of the blower systems will be skid-mounted, piped, and pre-wired for connection and operation. All wiring and controls will be suitable for Class I, Division I hazardous environments (i.e., explosion-proof).

To winterize the blowers and water removal system, both blower skids will be housed in a prefabricated building that will be set in place before connection. A concrete pad will be constructed as a base for the new equipment compound. Approximate dimensions for this pad are 40 feet wide by 60 feet long. The concrete pad will be at least 6 inches thick and use concrete of acceptable strength to handle the equipment loading.

Appendix A includes example equipment specifications for the vacuum blowers. The HWG will solicit bids for this equipment prior to procurement for the VCS upgrade.

2.4 THERMAL OXIDIZERS

As with the blowers, two thermal oxidizers will be installed capable of treating up to 750 cfm of air from the blowers. At this capacity, one thermal oxidizer will be matched with one blower. Piping connections will include valves to allow for operating either blower with one or both of the thermal oxidizers. This will provide sufficient redundancy to maximize system uptime.

The design includes the use of a high-efficiency thermal oxidizer. This type of unit will utilize the BTU value from the extracted hydrocarbons as the primary fuel with natural gas as assist gas. It is anticipated the operating temperature will be between 1,400 and 1,600 °F. Expected destruction efficiency is at least 99%.

These systems will be skid-mounted, piped, and pre-wired for final connection. All wiring and equipment will be suitable for Class I, Division I hazardous environments (i.e., explosion-proof).

Construction materials and coatings will allow for outdoor operation of these systems all year long. No winterization will be necessary on the equipment. The thermal oxidizers will be located on the system equipment pad along with the blowers and condensate collection tank. Utilities (including natural gas and electric) will be brought to the treatment area for connection to the equipment.

To provide the necessary safety throughout the system, flame arrestors will be installed on all influent air to the thermal oxidizers including from the wells, quench air, and combustion air.

2.5 CONDENSATE COLLECTION TANK

A 1,000-gallon condensate collection tank will be installed to collect water that accumulates in the knockout vessels. Float-controlled pumps will direct the collected water to this tank. A high-level and high-high-level float switch will be installed in this tank to provide an alarm and system shutdown in the event of high-level in the tank. The VCS is not designed to extract water; therefore, this tank capacity should be sufficient for temporary collection prior to disposal.

As noted in comment number 2 of the Agency's April 8, 2004 approval, the water accumulated in the tank will be periodically removed via a vacuum tanker truck and transported offsite for proper treatment and disposal.

The condensate collection tank will be situated on the concrete pad with the other system equipment. The concrete pad will be constructed with sufficient curbing to contain any spills/releases from the condensate tank. A building with explosion-proof ventilation and heating will be constructed around the tank to allow for winter operation. Connection piping from the blower skids will be heat-traced and insulated to allow winter operation.

2.6 REMOTE TELEMETRY AND ALARM MONITORING

Each skid (blowers and thermal oxidizers) will have remote monitoring instruments interconnected to either an independent onboard programmable logic controller (PLC) interconnected with others or into one main PLC for control. Figure 2-4 illustrates the preliminary process and instrumentation drawing for the new VCS equipment.

Since none of the equipment has been finalized with vendors, this figure represents minimum monitoring and alarm requirements. In general, all monitoring inputs (i.e., flow rates, temperatures, vacuums, differential pressure, etc.) will be used to continuously monitor the system performance. The PLC will be capable of both onsite and remote system control, datalogging, and some level of "view-only" for Agency monitoring of system performance. It is noted that comment number 9 of the April 8, 2004 approval letter required remote "view-only" access be provided to the Agencies along with a weekly data summary.

2.7 PERMITTING

As noted in comment number 11 of the Agency's April 8, 2004 approval letter, a new air discharge construction and operation permit will be required to install new blowers and thermal oxidizers. The Illinois EPA has been contacted to determine the type of permit required for this system and discuss the concept of permitting a system essentially owned by three different oil companies. Mr. Jason Schnepp of the Illinois EPA Bureau of Air indicated a joint construction and operation permit should be submitted for the new equipment. The Illinois EPA will accept a permit application with three signatures from the HWG member companies.

Clayton will determine if any local building permits are required for the system upgrade. If necessary, Clayton will obtain the appropriate permits prior to conducting work on the system upgrade.

3.0 VAPOR CONTROL SYSTEM LAYOUT

3.1 REPLACEMENT EXTRACTION WELLS

As previously stated, the new extraction wells will be installed within approximately 10 feet of the existing VCBs providing subsurface utilities do not prohibit such a location. The extraction well location will be selected to provide the most direct and feasible connection route to the existing VCB. Upon completion of the installation of the new extraction wells, each well location will be surveyed and plotted on a map for future reference.

Thirty vacuum monitoring points are proposed for the northern portions of the Village. The monitoring points have been preliminarily located at varying distances and directions from the proposed extraction well locations. The locations were selected so each new extraction well location would have a relatively close monitoring point (within 25 to 50 feet), an intermediate monitoring point (50 to 125 feet), and a distant monitoring point (125 to 200 feet). This will allow extrapolation of ROI data from each extraction well to at least 200 feet. In addition, the monitoring point locations were selected to allow at least one ROI reading to be collected in all directions (north, south, east, west) around each extraction well.

The ultimate location of these monitoring points will depend on the presence of potential subsurface (i.e., utilities) and overhead obstructions (i.e., wires) that may prohibit drilling in a particular location.

Upon completion of the installation of the monitoring points, each location will be surveyed and plotted on a map for future reference. The proposed monitoring point locations have been provided in Figure 3-1.

3.2 NEW SYSTEM EQUIPMENT

One of the VCS upgrade objectives is to keep the current system operational for as long as possible during construction. In order to minimize disruption of the current system, it is necessary to locate the new equipment compound west along the current underground piping. Figure 3-2 shows the proposed location for the new treatment compound.

The treatment compound pad will be located at least 20 feet south of the existing underground piping. This area is currently open and not planned for future use by Premcor. Furthermore, no utilities are located in the area that would preclude belowground work as part of the site preparation.

All equipment and utilities will be installed at this location prior to any connection to the existing well network. Once it is verified that the equipment is operational, the final connection to the well network will be accomplished. This will require excavation to the underground pipeline, cutting, and installing a tee and valves. The tee will allow the existing blowers and TTU to continue system operation should there be a catastrophic failure during the new equipment startup/shakedown.

Following the successful transition from the old equipment to the new equipment, the old system will be dismantled and removed from the site. As part of the demolition, a blind flange will be installed at the inlet from the belowground pipe.

4.0 VAPOR CONTROL SYSTEM OPERATION

4.1 WELL REPLACEMENT RESTART

Since it is unknown whether the current TTU can handle the additional hydrocarbon loading, the valves for the new wells will be closed, and the system will continue to operate through the existing VCBs during construction. Prior to any equipment upgrades, the current TTU will be tested by opening the new wells to determine if additional loading can be treated. The existing VCBs will not be grouted until it can be determined that the existing TTU can handle the additional loading and/or the new equipment is installed and operational. It is hoped that some additional hydrocarbon extraction from the new wells can be accomplished with the existing TTU while additional system upgrades and new equipment are brought online.

4.2 NEW SYSTEM EQUIPMENT STARTUP AND SHAKEDOWN

Prior to connection to the well network, the new equipment will be operated with 100% ambient air dilution (air dilution valves fully open) as part of the system "shakedown." During this period, the system(s) operating parameters (vacuums, flow rates, temperatures, amperage loads, noise levels, etc.) will be monitored to ensure appropriate operating conditions. The systems will also be monitored for excessive and unsuspected pressure swells/drops (i.e., line blockage/leakage) during shakedown. This procedure will be conducted independently for each blower and thermal oxidizer. To complete the final system shakedown, all blowers and thermal oxidizers will be operated at the same time while conducting operational parameter measurements. The shakedown period will be complete when all of the equipment operation is within acceptable limits and all alarm conditions/notification procedures are verified in working order.

Following the shakedown period, the current system will be taken offline, and excavation to the underground connection point will begin. As indicated in Section 3.2, the existing underground line will be cut, and a tee with two valves (one to the current system and one to the new system) will be installed. The new piping will be connected to the new equipment.

Immediately following the connection period, the new blowers and thermal oxidizers will be started using 100% dilution air. When the equipment is verified to be operating properly, the main valve to the well network will be opened, at which point each individual extraction well will be incrementally opened to allow for subsurface air extraction. During this period, the system(s) operating parameters (vacuums, flow rates, temperatures, amperage loads, noise levels, etc.) will again be closely and continually monitored to ensure appropriate operating conditions. Once each extraction well has been fully opened, the ambient air dilution valve for each SVE system will be incrementally closed to allow for maximum airflow from each well network within the Village of Hartford.

Once the operation with the wells online is verified, the airflow rates at the extraction wells will be balanced (using butterfly valves) based on flow from each well, vacuum at the well, and vacuum response readings from nearby vacuum monitoring probes. With the initiation of subsurface air extraction, the influent and effluent air stream concentrations (VOCs) and temperatures will be monitored to ensure appropriate loading and effluent concentrations.

It is anticipated that the majority of balancing of the VCS will occur during the first several months of operation, with decreasing balancing needed over time. However, it is recognized that seasonal conditions (i.e., precipitation events, water table fluctuations, changing ambient and subsurface air temperatures) will likely require flow rate/vacuum adjustments to ensure system balance and optimal removal effectiveness.

4.3 LONG-TERM OPERATION, MAINTENANCE, AND MONITORING

Long-term operation, maintenance, and monitoring of the upgraded VCS will begin following successful shakedown and startup. As noted in comment number 10 of the Agency's April 8, 2004 approval letter, an Operation Maintenance and Monitoring Plan (OMMP) will be prepared. A draft of this plan will be available prior to the new system startup. Following successful startup, the OMMP will be modified as necessary to reflect any changes or new information on the operation.

The OMMP will be prepared to provide the framework for the implementation of operation, maintenance, and monitoring activities for the upgraded VCS. The OMMP will address the following minimum elements:

- Operation and maintenance protocol will be provided for the various components and control systems associated with the VCS. The respective operation and maintenance protocol will be organized according to startup/optimization and long-term operation tasks.
- Routine maintenance requirements, protocol, and frequency will be described to provide a baseline for the long-term operation of the VCS.
- Potential key operating problems and associated corrective measures will be provided as a reference for potential system troubleshooting needs.
- Monitoring/sampling protocol and frequency will be included to allow for the evaluation of remediation progress.
- Periodic reporting requirements for the remediation activities will be outlined in the OMMP. Furthermore, reporting/notification requirements based on both scheduled and unscheduled system downtime will be included.

As noted in comment number 1 of the Agency's April 8, 2004 approval letter, groundwater elevation measurements will be included in the monitoring program to evaluate ongoing VCS efficiency.

5.0 CONSTRUCTION SCHEDULE

A construction schedule for the VCS system upgrade has been modified to reflect the Agency approval date of April 8, 2004 (Figure 5-1). The construction schedule assumes the construction and operation permit can be obtained within 6 weeks, and subcontractors are immediately available to complete the construction activities.

It should be noted that equipment vendors have not yet been identified, therefore delivery timeframes in the schedule may change. Furthermore, the time for system construction activities is based on generalized assumptions for level-of-effort. These timeframes may change once bid packages have been prepared and final bids are received from the contractors. In the event that the schedule will change due to these factors, the Agency will be notified in writing.

The schedule includes construction contingency to address bad weather and other issues that may arise during construction. It is assumed the Agencies will approve the design by mid-June so that equipment procurement can be completed to meet the installation schedule.

As noted in comment number 7 in the Agency's April 8, 2004 approval letter, the HWG will provide Hartford residents and all other interested parties at least 7 days' notice prior to any work conducted in the village.

FIGURES

TABLES

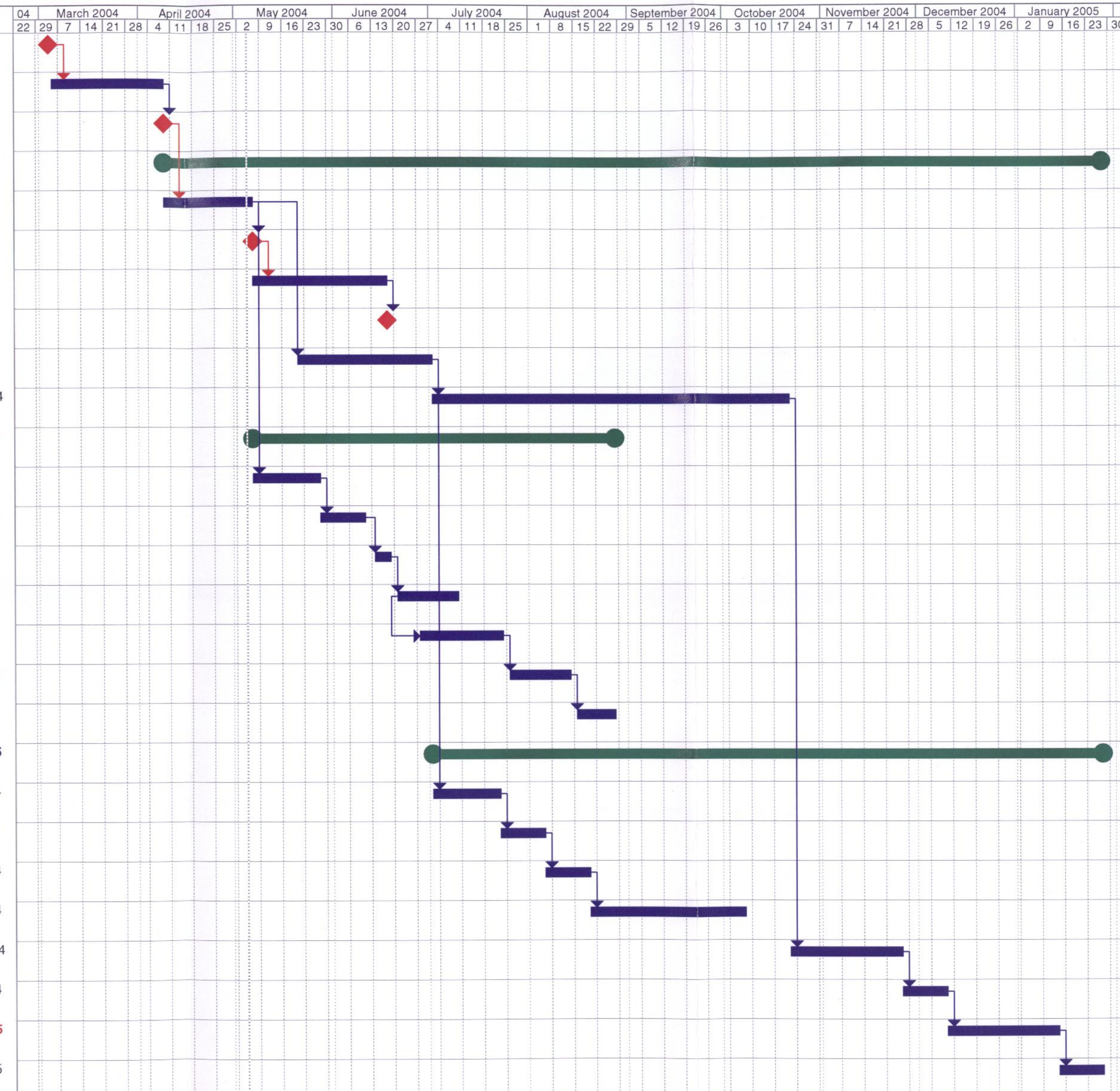
APPENDIX A

EXAMPLE EQUIPMENT SPECIFICATIONS

Figure 5-1
VCS Upgrade Schedule
Hartford, Illinois

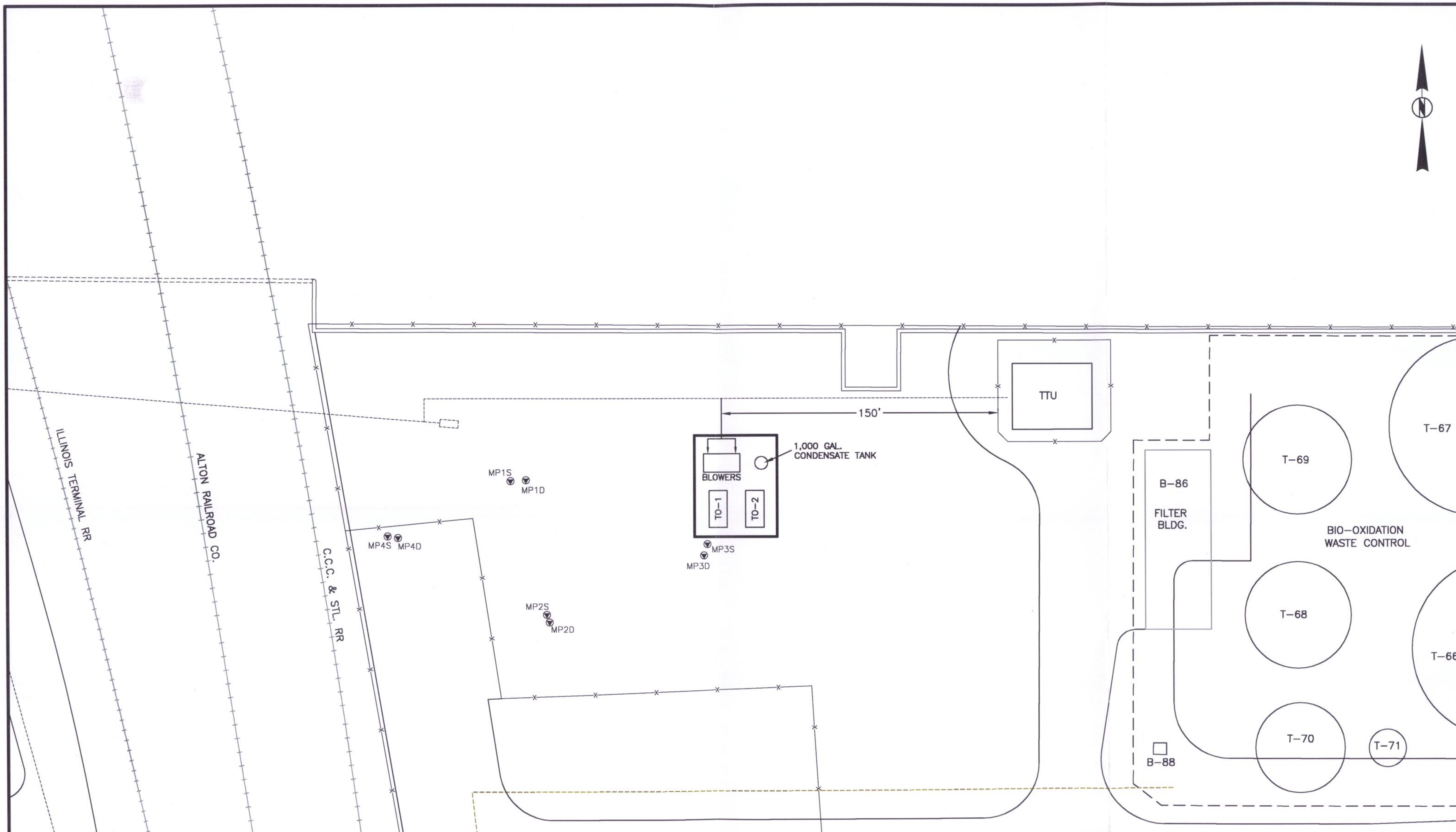
Clayton GROUP SERVICES

ID	Task Name	Duration	Start	Finish
1	*Submit SVE Pilot Test Report & VCS Upgrade Work Plan to USEPA*	*0 days*	*Thu 3/4/04*	*Thu 3/4/04*
2	Review of Report & Work Plan by USEPA	5 wks	Fri 3/5/04	Thu 4/8/04
3	*Approval of VCS Upgrade Work Plan*	*0 days*	*Thu 4/8/04*	*Thu 4/8/04*
4	**VAPOR CONTROL SYSTEM UPGRADE**	**210 days**	**Fri 4/9/04**	**Thu 1/27/05**
5	Develop VCS Upgrade Technical Memorandum	4 wks	Fri 4/9/04	Thu 5/6/04
6	*Submit VCS Upgrade Technical Memorandum to USEPA*	*0 days*	*Thu 5/6/04*	*Thu 5/6/04*
7	Review of VCS Upgrade Technical Memorandum by USEPA	30 days	Fri 5/7/04	Thu 6/17/04
8	*Approval of VCS Upgrade Technical Memorandum*	*0 days*	*Thu 6/17/04*	*Thu 6/17/04*
9	Air Discharge Permitting	6 wks	Fri 5/21/04	Thu 7/1/04
10	Procure Equipment	16 wks	Fri 7/2/04	Thu 10/21/04
11	**VCS Well Upgrade**	**81 days**	**Fri 5/7/04**	**Fri 8/27/04**
12	Solicit Contractors for Construction Quotes	3 wks	Fri 5/7/04	Thu 5/27/04
13	Evaluate Quotes/Choose Contractor	2 wks	Fri 5/28/04	Thu 6/10/04
14	Clear Utilities/Site Preparation	1 wk	Mon 6/14/04	Fri 6/18/04
15	New Well/Vapor Monitoring Probe Installation	3 wks	Mon 6/21/04	Fri 7/9/04
16	Excavate Existing VCBs for Connection	4 wks	Mon 6/28/04	Fri 7/23/04
17	**Construction Contingency**	**3 wks**	**Mon 7/26/04**	**Fri 8/13/04**
18	Vapor Control System Restart	2 wks	Mon 8/16/04	Fri 8/27/04
19	**VCS New Equipment Installation**	**150 days**	**Fri 7/2/04**	**Thu 1/27/05**
20	Solicit Contractors for Construction Quotes	3 wks	Fri 7/2/04	Thu 7/22/04
21	Evaluate Quotes/Choose Contractor	2 wks	Fri 7/23/04	Thu 8/5/04
22	Clear Utilities/Site Preparation	2 wks	Fri 8/6/04	Thu 8/19/04
23	Treatment Compound Construction	7 wks	Fri 8/20/04	Thu 10/7/04
24	New Equipment Delivery/Installation	5 wks	Fri 10/22/04	Thu 11/25/04
25	Final System Connection	2 wks	Fri 11/26/04	Thu 12/9/04
26	**Construction Contingency**	**5 wks**	**Fri 12/10/04**	**Thu 1/13/05**
27	System Startup/Shakedown	2 wks	Fri 1/14/05	Thu 1/27/05



Project: VCS Upgrade Sch_Rev 3
Date: Wed 5/5/04

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone



LEGEND:

⊛ MONITORING PROBE

SCALE IN FEET

0 20 40 80

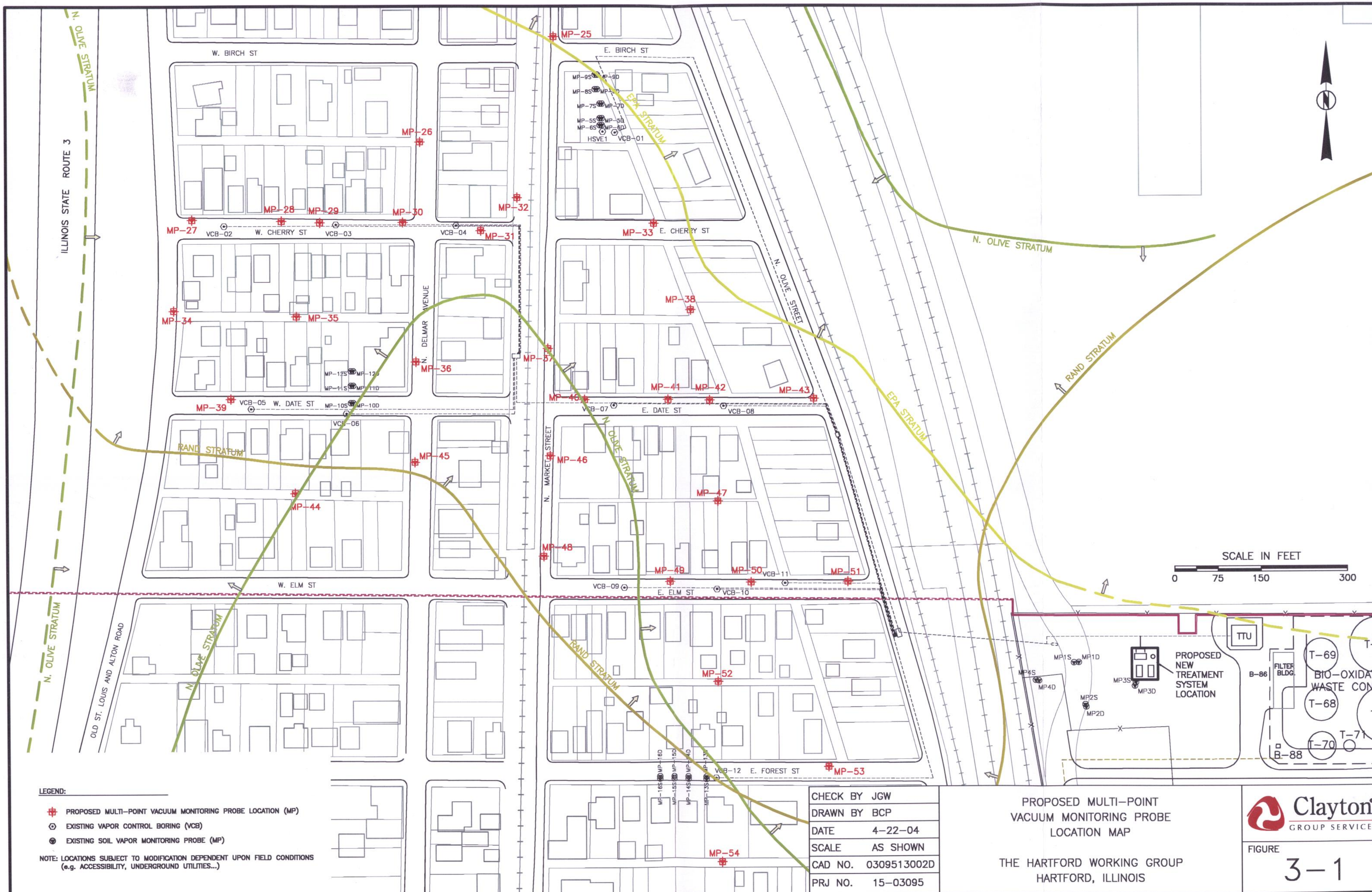
CHECK BY	JLP
DRAWN BY	BCP
DATE	4-22-04
SCALE	AS SHOWN
CAD NO.	0309513002E
PRJ NO.	15-03095

PRELIMINARY SYSTEM LAYOUT FOR NEW BLOWERS AND THERMAL OXIDATION UNITS

THE HARTFORD WORKING GROUP
HARTFORD, ILLINOIS

Clayton GROUP SERVICES

FIGURE 3-2



W. BIRCH ST
E. BIRCH ST
W. CHERRY ST
E. CHERRY ST
W. DATE ST
E. DATE ST
W. ELM ST
E. ELM ST
E. FOREST ST
N. DELMAR AVENUE
N. MARKET STREET
N. OLIVE STREET
ILLINOIS STATE ROUTE 3
OLD ST. LOUIS AND ALTON ROAD
N. OLIVE STRATUM
EPA STRATUM
RAND STRATUM
MP-25
MP-26
MP-27
MP-28
MP-29
MP-30
MP-31
MP-32
MP-33
MP-34
MP-35
MP-36
MP-37
MP-38
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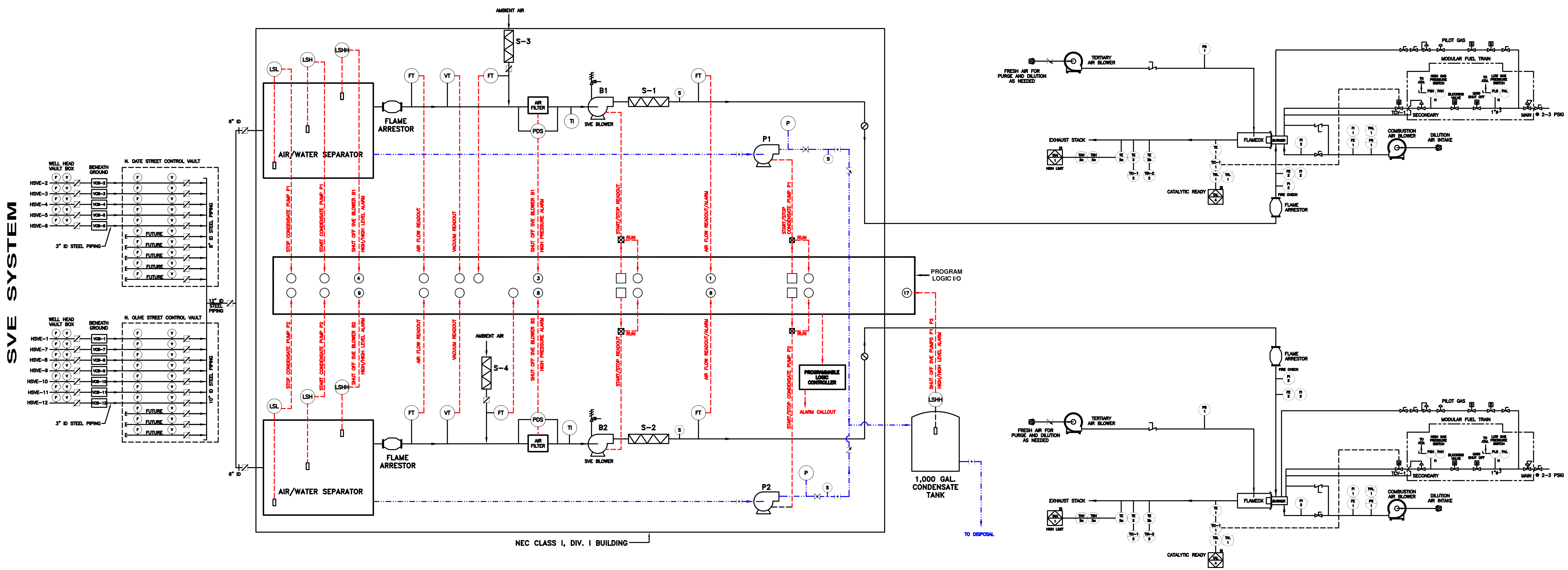
VCB-10
VCB-11
VCB-12
HSVE1
MP-5S MP-5D
MP-6S MP-6D
MP-7S MP-7D
MP-8S MP-8D
MP-9S MP-9D
MP-10S MP-10D
MP-11S MP-11D
MP-12S MP-12D
MP-13S
MP-14S MP-14D
MP-15S MP-15D
MP-16S MP-16D
MP1S MP1D
MP2S MP2D
MP3S MP3D
MP4S MP4D
PROPOSED NEW TREATMENT SYSTEM LOCATION
TTU
B-86
FILTER BLDG.
BIO-OXIDAT
WASTE CONT
T-69
T-68
T-70
T-71
B-88
SCALE IN FEET
0 75 150 300
LEGEND:
PROPOSED MULTI-POINT VACUUM MONITORING PROBE LOCATION (MP)
EXISTING VAPOR CONTROL BORING (VCB)
EXISTING SOIL VAPOR MONITORING PROBE (MP)
NOTE: LOCATIONS SUBJECT TO MODIFICATION DEPENDENT UPON FIELD CONDITIONS (e.g. ACCESSIBILITY, UNDERGROUND UTILITIES...)
CHECK BY JGW
DRAWN BY BCP
DATE 4-22-04
SCALE AS SHOWN
CAD NO. 0309513002D
PRJ NO. 15-03095
PROPOSED MULTI-POINT VACUUM MONITORING PROBE LOCATION MAP
THE HARTFORD WORKING GROUP
HARTFORD, ILLINOIS
Clayton GROUP SERVICES
FIGURE 3-1

VAPOR CONTROL SYSTEM UPGRADE
SYSTEMS PROCESS AND INSTRUMENTATION



LEGEND – SVE SYSTEM

- P PRESSURE GAUGE
- F FLOW GAUGE/METER
- FT FLOW TRANSMITTER
- VT VACUUM TRANSMITTER
- PT PRESSURE TRANSMITTER
- V VACUUM GAUGE
- LSL LOW LEVEL SWITCH
- LSH HIGH LEVEL SWITCH
- LSHH HIGH/HIGH LEVEL SWITCH
- T TEMPERATURE MONITORING POINT
- TI TEMPERATURE INDICATOR
- PDS DIFFERENTIAL PRESSURE SWITCH
- S SAMPLE PORT
- BALL VALVE
- GATE VALVE
- BUTTERFLY VALVE
- CHECK VALVE (WATER)
- CHECK VALVE (AIR)
- VACUUM RELIEF VALVE
- DIGITAL OUTPUT (DO)
- DIGITAL INPUT (DI)
- STARTER
- BLOWER/PUMP
- SILENCER
- CONTROL WIRING
- AIR
- WATER

LEGEND – THERMAL OXIDIZERS

- PS 1 PRESSURE SWITCH
- PDAH 1 PRESSURE DIFFERENTIAL ALARM HIGH
- DPS 1 DIFFERENTIAL PRESSURE SWITCH
- TAH 2a TEMPERATURE ALARM HIGH
- TSH 2a TEMPERATURE SWITCH HIGH
- TAL 1 TEMPERATURE ALARM LOW
- TSL 1 TEMPERATURE SWITCH LOW
- TE 2 TEMPERATURE PRIMARY ELEMENT
- TIC-1 2 TEMPERATURE INDICATOR CONTROLLER
- TIR-2 2 TEMPERATURE INDICATOR RECORD
- FI 3 FLOW RATE INDICATOR
- FE 3 FLOW RATE PRIMARY ELEMENT
- PI 2 PRESSURE INDICATOR
- PAL 1 PRESSURE ALARM LOW
- PLS PRESSURE LOW SWITCH
- PSH PRESSURE SWITCH HIGH
- PAH PRESSURE ALARM HIGH
- BALANCING DAMPER
- VALVE NORMALLY OPEN
- PRESSURE SWITCH (EXTERNAL BACKLOAD)
- PRESSURE REGULATOR (SELF CONTAINED)
- SOLENOID
- ELECTRIC MOTOR
- CONTROL WIRING

NOTE:

1. THE THERMAL OXIDIZERS ARE CAPABLE OF OPERATION IN A CATALYTIC MODE. HOWEVER, THE UNITS WILL NOT BE OPERATED IN THIS MODE FOR THE HARTFORD PROJECT.
2. EACH THERMAL OXIDIZER WILL HAVE A PLC CONTROLLING OPERATION AND COMMUNICATING WITH THE BLOWERS.

NO.	DATE	BY	REVISIONS
1	5-6-04	JLP	DRAFT DESIGN

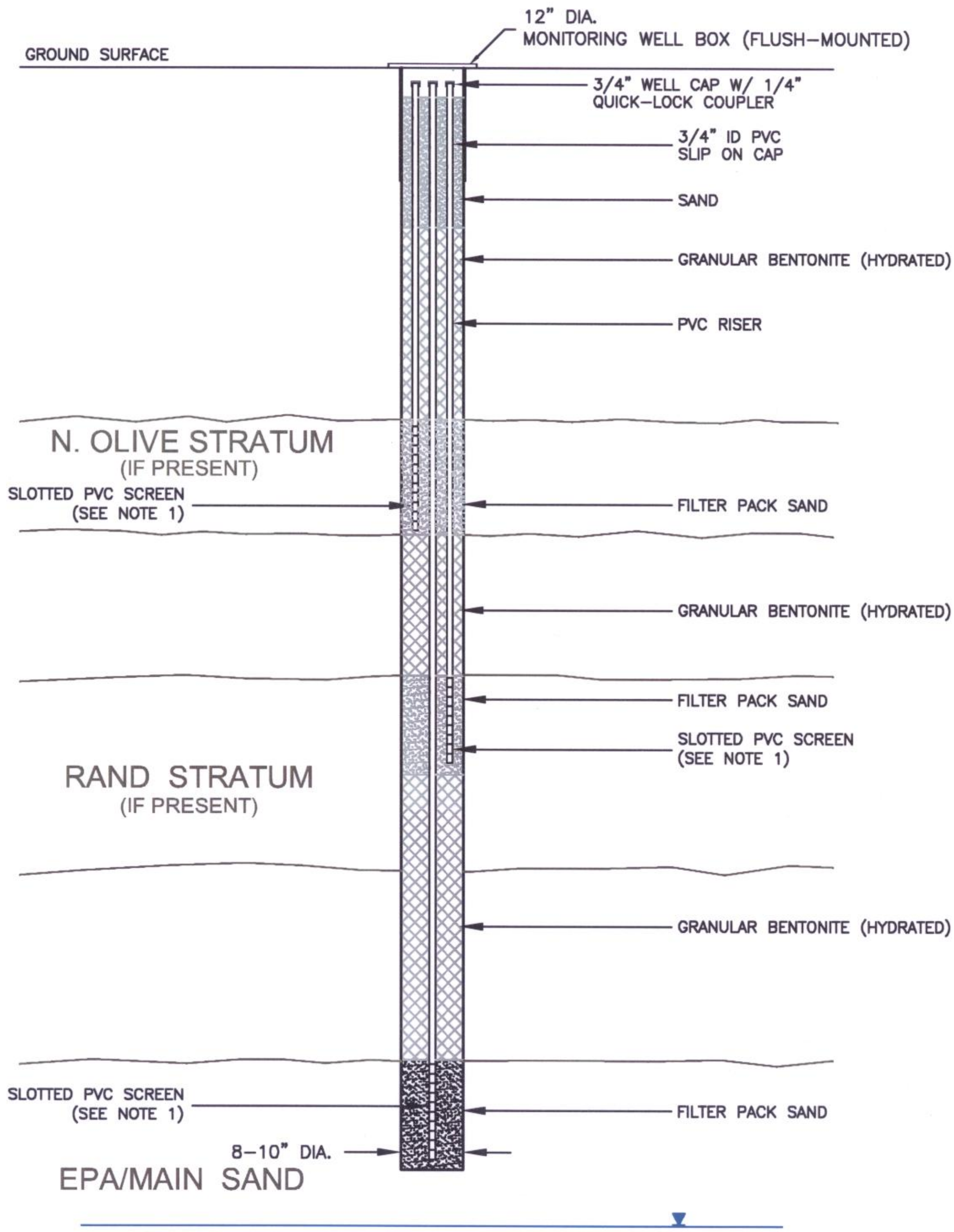
DESIGN BY: JLP
CHECKED BY: JGW
DRAWN BY: BCP
DATE: 4-22-04
SCALE: NONE
CAD NO.: 0309513002c
PROJECT NO.: 03905.13-002

Clayton GROUP SERVICES

VAPOR CONTROL SYSTEM UPGRADE
PROCESS AND INSTRUMENTATION DIAGRAM

HARTFORD WORKING GROUP
HARTFORD, ILLINOIS

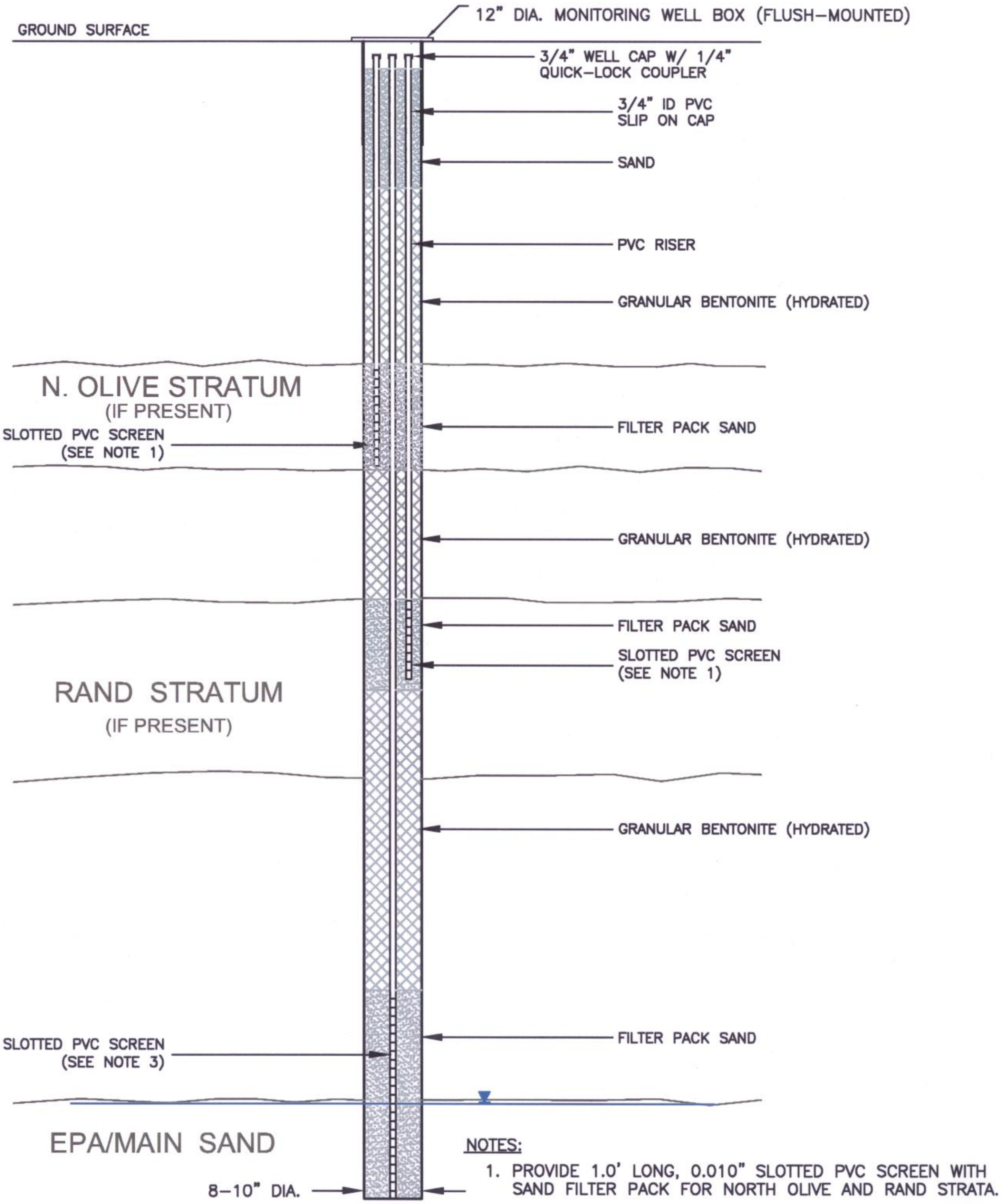
FIGURE 2-4



NOTES:

1. PROVIDE 1.0' LONG, 0.010" SLOTTED PVC SCREEN WITH SAND FILTER PACK.
2. DEPTH OF BOREHOLE AND PLACEMENT OF WELL SCREEN MAY BE MODIFIED BASED ON SUBSURFACE CONDITIONS.

CHECK BY	JGW	TYPICAL MULTI–POINT VACUUM MONITORING PROBE CONSTRUCTION DETAILS (UNCONFINED CONDITIONS)	Clayton GROUP SERVICES
DRAWN BY	BCP		
DATE	4–22–04		
SCALE	NONE	THE HARTFORD WORKING GROUP HARTFORD, ILLINOIS	FIGURE 2–3
CAD NO.	0309513002B		
PRJ NO.	15–03095.13		



NOTES:

1. PROVIDE 1.0' LONG, 0.010" SLOTTED PVC SCREEN WITH SAND FILTER PACK FOR NORTH OLIVE AND RAND STRATA.
2. DEPTH OF BOREHOLE AND PLACEMENT OF WELL SCREEN MAY BE MODIFIED BASED ON SUBSURFACE CONDITIONS.
3. PROVIDE 5.0' LONG, 0.010" SLOTTED PVC SCREEN WITH SAND FILTER PACK FOR EPA/MAIN SAND.

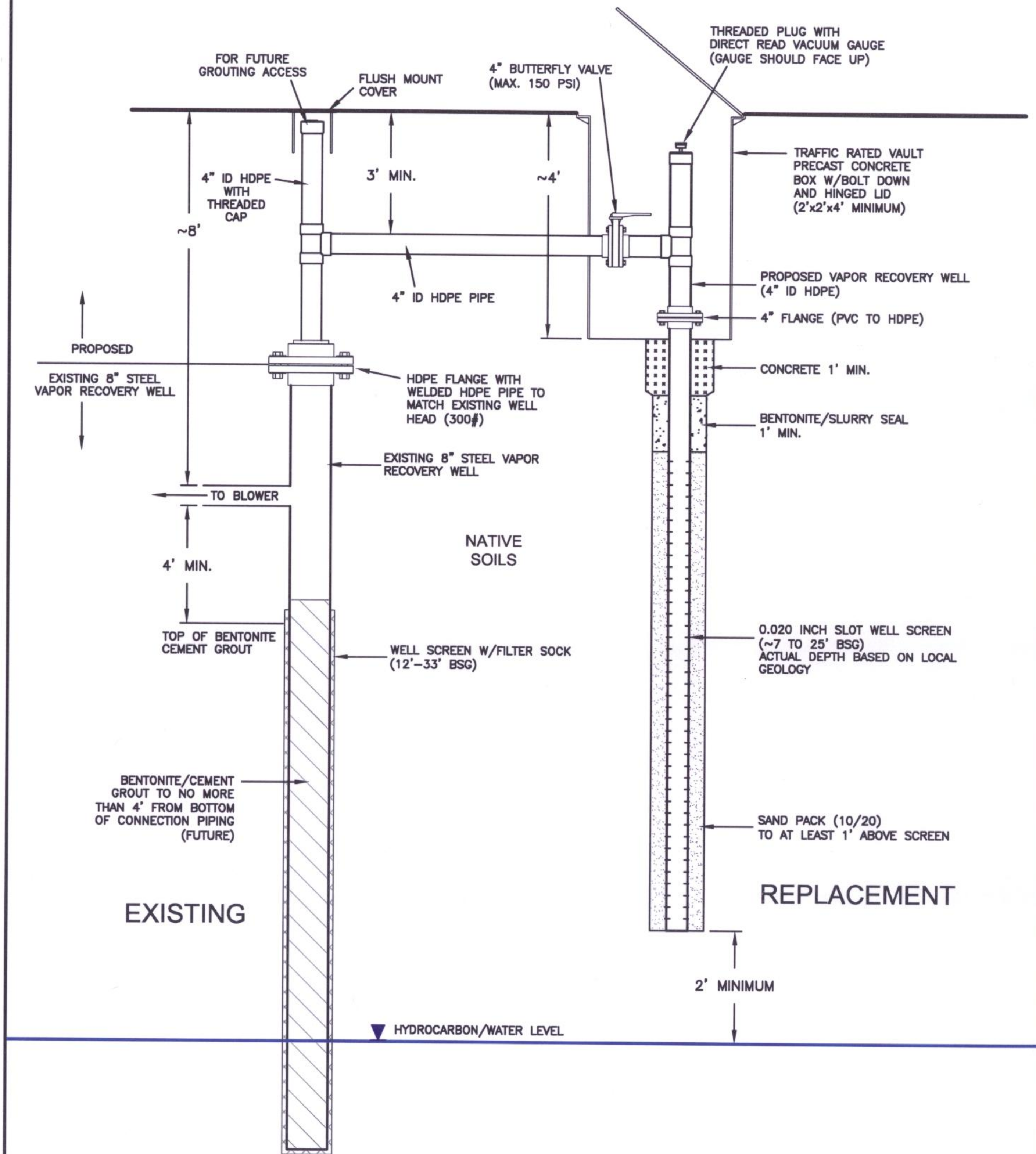
CHECK BY	JGW
DRAWN BY	BCP
DATE	4–22–04
SCALE	NONE
CAD NO.	0309513002B
PRJ NO.	15–03095.13

TYPICAL MULTI–POINT VACUUM MONITORING PROBE
CONSTRUCTION DETAILS
(CONFINED CONDITIONS)

THE HARTFORD WORKING GROUP
HARTFORD, ILLINOIS

Clayton GROUP SERVICES

FIGURE 2–2



CHECK BY	JGW	EXISTING AND REPLACEMENT VAPOR CONTROL WELL PROFILE	Clayton GROUP SERVICES
DRAWN BY	BCP		
DATE	4-22-04		
SCALE	NONE		FIGURE
CAD NO.	0309513002A	THE HARTFORD WORKING GROUP HARTFORD, ILLINOIS	2-1
PRJ NO.	15-03095.13		

TABLE 2-2
Proposed Multi-Point Monitoring Probe Installation Details

The Hartford Working Group / Hartford, Illinois

NEW PROBE	ANTICIPATED SCREENED STRATA	INTERPRETATION OF MAIN SAND CONDITIONS	APPROXIMATE SCREEN INTERVALS (feet bgs)	
MP-25	N. Olive, Rand, EPA	Confined	N. Olive Rand EPA	14-15 24-25 30-35
MP-26	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-27	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-28	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-29	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-30	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-31	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-32	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-33	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-34	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-35	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-36	Rand, Main	Confined	Rand Main	24-25 25-30
MP-37	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-38	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-39	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30
MP-40	N. Olive, Rand, Main	Confined	N. Olive Rand Main	14-15 24-25 25-30

TABLE 2-2
Proposed Multi-Point Monitoring Probe Installation Details

The Hartford Working Group / Hartford, Illinois

NEW PROBE	ANTICIPATED SCREENED STRATA	INTERPRETATION OF MAIN SAND CONDITIONS	APPROXIMATE SCREEN INTERVALS (feet bgs)	
MP-41	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-42	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-43	N. Olive, Rand, Main	Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-44	N. Olive, Main	Unconfined	N. Olive Main	14-15 29-30
MP-45	Rand, Main	Unconfined	Rand Main	24-25 29-30
MP-46	Rand, Main	Confined	Rand Main	24-25 29-30
MP-47	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-48	Rand, Main	Confined	Rand Main	24-25 29-30
MP-49	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-50	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-51	N. Olive, Rand, Main	Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-52	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-53	N. Olive, Rand, Main	Confined/ Unconfined	N. Olive Rand Main	14-15 24-25 25-30
MP-54	Main	Confined/ Unconfined	Main	25-30

NOTES:

MP = Monitoring Probe
bgs = below ground surface

Interpretation of Main Sand Conditions is an evaluation as to whether confining conditions may occur at a particular location based on the hydrogeologic conditions at a monitoring probe location. The evaluation of these conditions is an initial guide to the type of monitoring probe installation that will be implemented at a location. Those interpreted as Confined/Unconfined will likely receive a confined monitoring probe design installation. Final determination to be made in the field.

TABLE 2-1
Proposed Soil Vapor Extraction Well Installation Details

The Hartford Working Group / Hartford, Illinois

NEW WELL	FORMER WELL	ANTICIPATED SCREENED STRATA	DISTANCE TO MAIN SAND FROM SCREEN BOTTOM (feet bgs)	SCREEN INTERVAL (feet bgs)	APPROXIMATE WATER LEVEL IN MAIN SAND (feet bgs)
HSVE-1	VCB-1	N. Olive	~12	7 - 17	~35
HSVE-2	VCB-2	N. Olive, Rand, Main	--	7 - 27	~32
HSVE-3	VCB-3	N. Olive, Rand	~5	7-27	~34
HSVE-4	VCB-4	N. Olive, Rand	~2	7-27	~34
HSVE-5	VCB-5	N. Olive, Rand, Main	--	7-27	~33
HSVE-6	VCB-6	N. Olive, Rand	~1	7-27	~33
HSVE-7	VCB-7	N. Olive, Rand	~2	7-27	~31
HSVE-8	VCB-8	N. Olive, Rand	~0	7-27	~31
HSVE-9	VCB-9	Rand, Main	--	7-27	~30
HSVE-10	VCB-10	N. Olive, Rand, Main	--	7-27	~30
HSVE-11	VCB-11	N. Olive, Rand, Main	--	7-27	~30
HSVE-12	VCB-12	N. Olive, Rand, Main	--	7-27	~30

NOTES:

-- = New well will extend into the Main Sand.
HSVE = Hartford Soil Vapor Extraction
VCB = Vapor Control Boring
HSVE-series wells to replace existing VCB-series wells
bgs = below ground surface
HSVE-1 was installed on January 7, 2004.

Approximate water level information was obtained during 1/04 and 2/04 from existing monitoring wells and interpreted from cone penetration testing probe data.

TCL
PROCESS
TECHNOLOGIES

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Clayton Consulting Group

HARTFORD WORK GROUP REFINERY

SOIL VAPOR EXTRACTION SYSTEM

Submitted by Maple Leaf Environmental Equipment Ltd.
In co-operation with Tom Lawn of TCL Process Technologies

• February 19, 2004 •

Quote Number: 400368R0

CONTENTS

Introduction

Maple Leaf Environmental Equipment Ltd. has been given the opportunity to provide a quote for a soil vapor extraction system C/W controls mounted in a fully assembled treatment building. The system is for remediation of a Clayton Consulting Group site in Hartford, IL. The equipment proposal we have provided in this document is based on our understanding of your requirements.

The following sections review the design of the system and detail the individual components. The information provided in this proposal may be modified prior to the construction of the equipment. If no modifications are required, the system will be built as specified, for the price quoted, within the delivery time specified.

We look forward to obtaining approval to begin fabrication of this system.

Submitted by:
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Brockville, ON K6V 5Y6
Voice (613) 498-1876 Fax (613) 345-7633
E-mail info@maple-leaf.ca
WWW.MAPLE-LEAF.CA

Maple Leaf Environmental Equipment Ltd.

CORPORATE PROFILE

Maple Leaf Environmental Equipment Ltd. is a North American manufacturer and supplier of wastewater treatment equipment, groundwater/site remediation systems, drinking water treatment systems, and PLC based control panels.

Since 1992, MLE has supplied high quality treatment equipment to the Canadian, United States, and international markets.

With over 50 years of combined technical experience in petroleum/water separation, water treatment and project management, MLE staff continues to lead in the design and application of innovative new technologies in the environmental business.

MLE is also the exclusive Canadian distributor for QED Environmental Systems, Inc. groundwater sampling and remediation pumps, sample filters, interface meters and air strippers.

Technical Notes

Engineering Assumptions:

460V three-phase power available

Hazardous CL 1 DIV 1 location for equipment

Ambient up to 100 degrees F

Altitude 430 feet

Design Parameters:

TWO VACUUM EXTRACTION SYSTEMS, EACH WITH:

SVE system capacity – 750 SCFM at 100" WC

MLEE 240 G vapor liquid separator

Transfer pump from vapor liquid separator - 10 GPM @ 20' TDH

ENCLOSURE MODULE:

System mounted in 8'x 20' enclosure, piped, wired and tested; all wiring suitable for Class 1 Div 1 locations

CONTROL PANEL:

PLC based control system with control and alarm features

Budgetary Pricing & Equipment Description

ROTARY LOBE SOIL VAPOUR EXTRACTION BLOWER MODULE (2)

Includes: **Sutorbilt 6L rotary lobe blower** with 30 HP 230/460V/3P EXP motor:

- *Discrete output*
- Performance at inlet of system: 750 ACFM at 100""WC
- Expected inlet pressure losses through MLE system: 15" WC
- Discharge temperature: 139.9F at an ambient of 100 F
- Noise rating: 86.1 dBA

Inlet piping to blower to contain:

- Vacuum gauge
- Solberg inlet filter/silencer
- Sample port
- Dilution valve with Solberg filter/silencer
- Vacuum gauge
- Vacuum relief valve
- PVC piping

Discharge piping from blower to contain:

- Discharge silencer
- Sample port
- Pressure gauge
- Temperature gauge
- Air flow transmitter - *analog input*
    - Pitot tube air flow transmitter
- Galvanized steel piping

VAPOR LIQUID SEPARATOR MODULE (2)

Includes: **VLW-240, 240 G vapor liquid separator** with:

- Epoxy coated exterior
- ½"sight glass
- High level alarm switch - *discrete input*

- High level pump control switch - <u>*discrete input*</u>
- Low level pump control switch - <u>*discrete input*</u>
- Manual drain

Liquid discharge piping from vapor liquid separator to contain:

- Ball valve
- **Gould's NPE model 1ST centrifugal transfer pump** with 1/2 HP 230/460V/3P EXP motor:
  - <u>*Discrete output*</u>
  - Performance: 10 GPM at 50' TDH
- Pressure gauge
- Sample port
- Gate valve
- Check valve
- PVC piping

<u>Remediation Enclosure</u>

Built to NEC Class 1 Div 1 standards, all wiring intrinsically safe and all equipment pre-piped factory tested and mounted in enclosure

Includes 8' x 20' <u>modified shipping container</u> with the following standard features:

- Exterior paint
- Lifting eyes on upper corners
- Bolt down tabs on lower corners
- Plywood floor
- Insulated walls and ceiling
- Barn-style rear double doors

Interior to be rated hazardous and to contain the following:

- Vacuum extraction system
- Control panel
- Lighting - <u>*powered device*</u>
- Ventilation fan with thermostat and hood – <u>*discrete output*</u>
- Heater with thermostat - <u>*powered device*</u>
- Passive vent louvers with hood
- All influent, effluent, and drain lines plumbed to outside of building

<u>Control System</u>

Includes: PLC based contol panel with the following standard features:

- Nema 7 panel enclosure
- Primary circuit protection using fused main disconnect

- Surge and lightning protection for control system
- Surge and lightning protection for telephone line
- Main power block
- Branch circuit protection with circuit breakers for motors
- Motor starters with overload protection
- 120V/1P power transformer
- Branch circuit protection with circuit breakers for powered devices
- Direct Logic PLC control system
- Remote telemetry and communication package (MLE)
- 24 VDC IS power supply
- Intrisically safe barriers
- Programmable 24 hour on/off cycling timers
- Wired and installed
- Factory tested prior to shipping

Outside cover of inner swing panel to contain the following:

- HOA switches with green run lights
- Red alarm indicator light (1)
- User interface display screen
- Alarm reset button

OPERATION AND MAINTENANCE MANUAL

Includes:

Operating instructions for all treatment system components
Copy of operating manual for each piece of equipment
Summary of system components
Summary of system operation principals
Summary of operation controls and failsafes
Summary of maintenance requirements for each piece of equipment

INPUT: DESCRIPTION	DISCRETE	ANALOG	IS	ALM	TEL.
SVE air flow transmitter		2	2		STATUS
VLS high level alarm switch	1		1	1	STATUS
VLS high level pump control switch	1		1		STATUS
VLS low level pump control switch	1		1		STATUS
Building ventilation fan control switch	1		1		STATUS
Oxidizer system alarm	1			1	STATUS

OUTPUT: DESCRIPTION	MOTOR STARTER	HOA	RUN LIGHT	TEL.
SVE blower motor (2)	30 HP 460V/3P	2	2	STATUS
VLS transfer pump motor	.5 HP 460V/3P	2	2	STATUS
BLD hazardous ventilation fan motor	.5 HP 120V/1P			STATUS

Oxidizer Process Information

▪ Air Flow From SVE:	500 SCFM
▪ Minimum Air Flow:	250 SCFM
▪ Hydrocarbon Processing Capability:	250 lbs/hr
▪ Maximum Pressure Drop:	< 1 psig
▪ Gas Pre-Heater Operating Input:	250,000 BTUH
▪ Max Gas Pre-Heater Input:	1.5 MM BTUH
▪ Minimum Thermal Operating Temperature:	1400 degrees F.
▪ Average Thermal Operating Temperature:	1400-1600 degrees F.
▪ Maximum Thermal Operating Temperature:	1800 degrees F.
▪ Minimum Catalyst Inlet Temperature:	600 degrees F.
▪ Average Catalyst Operating Temperature:	650 degrees F.
▪ Maximum Catalyst Operating Temperature:	1200 degrees F.
▪ Catalyst Volume:	1.15 cubic feet
▪ Catalyst Gas Hourly Space Velocity:	39,000 $GHSV^{-1}$
▪ Catalyst Destruction Efficiency:	> 99% (all modes)
▪ Maximum Hydrocarbon Throughput:	50,000 ppmv (Flame mode)
▪ Est Time to Reach Operating Temperature:	30 minutes from cold start
▪ Total Fan Horsepower:	< 20
▪ Noise Level:	< 85 dBA at a distance of 10'

Sequence of Operation

High BTU Mode

The high concentration fume stream (SVE or MPE) is directed into a specially designed burner and utilized as supplemental fuel to the burner. Using the fume stream in this way does not require the process stream to be diluted, drastically reducing the amount of supplemental fuel required. Combustion air is supplied to the burner to maintain a stable flame. As the concentration level falls, supplemental fuel is automatically added to maintain a minimum temperature set point. As the temperature in the combustion chamber increases up to a maximum of 1800 degree F., additional air is introduced (tertiary air) into the combustion chamber to lower the internal temperature. The additional air is regulated from a temperature PID loop. As the temperature in the combustion chamber rises, more tertiary air is added to maintain the control temperature set point. Note: All combustion is maintained inside the combustion chamber and there is not a visible flame outside the oxidizer chamber.

Thermal Mode

Once the concentration levels decline to <40% LEL, the combustion chamber set-point temperature is lowered to between 1400-1500 degrees F. This minimizes the supplemental energy requirement to the burner in the absence of a self sustaining operation. In thermal mode at >25% LEL, the use of an approved LEL monitor/alarm device is required to maintain compliance with NFPA regulations.

Catalytic Mode

After the concentration levels decline to <25% LEL, the catalyst module can be inserted. The exhaust stack is removed and the catalytic module is inserted into the exhaust flange. The temperature control settings are manually changed to 650 deg F.

Heat Exchange Mode

A heat exchange module is available to operate in catalytic mode only. The heat exchange module is nominally 50% thermally efficient.

Key Advantages of the Flame-Ox

- The unit was specifically developed to operate on a free product or heavily contaminated site from start to finish, providing a single piece of equipment for all phases of operation while minimizing supplemental energy required

- Does not require reductions in LEL for safe operation. This allows the unit to process the entire fume stream without adding dilution air prior to combustion. This drastically reduces fuel consumption as compared to conventional thermal technologies.

- The unit injects cooling air into the combustion chamber to maintain temperature set-point during Flame Mode. Additional sources of air requiring treatment such as an air-stripper can be added without having to add additional supplementary fuel for treatment.

- The unit can process 10 times more hydrocarbon than a standard thermal oxidizer and 5 times more than an ICE Engine, thus clean-up time can be accelerated and clean-up objectives can be reached more quickly.

Equipment Specifications

Oxidizer Reactor

The reactor housing is constructed of 7 gauge hot rolled carbon steel. All internal reactor wetted surfaces of the unit shall be constructed of ceramic insulation media. The reactor insulation shall be 2200 deg F. rated ceramic block insulation.

Gas Pre-heater

The unit is equipped with a direct gas fuel fired primary air burner with combustion air blower. The gas pre-heater is controlled from the thermocouple and sized to provide sufficient energy to maintain combustion temperature. Flame supervision is achieved by use of a UV detector and approved flame safety programmer.

Fuel Gas Piping Assembly

The fuel gas piping assembly is pre-piped and pre-wired and meets all requirements as specified in NFPA 79, NFPA 86, NFPA 54 and is suitable for FM approval. Gas piping assembly consists of main shut-off, lubricated plug valve, main and pilot fuel gas pressure regulators, main fuel safety and blocking shut-off valves, pilot safety shut-off valve, high and low gas pressure switches, gas control valve with electrically-operated modulating control actuator, leak test cocks and manual ball valves in accordance with NFPA 86, indicating pressure gauges with shut-off cocks for incoming gas pressure, main regulated gas pressure, pilot-regulated gas pressure and burner gas pressure. A flexible connection is provided between the fuel gas piping assembly and the burner.

Detonation Arrestor

The detonation arrestor is installed on the inlet of the oxidizer burner, which is connected to the high concentration fume stream. The detonation arrestor has a thermal link to provide for source isolation in the event of flame propagation.

Main Control System

Nema 4 control panel completely assembled, wired and mounted at eye level. Main door interlocking electrical disconnect, power distribution circuit with step down 120V isolating transformer, solid state PID temperature controller, flame safety programmer with built in purge timer, Allen Bradley programmable logic controller, visual operator interface with first outage fault finder and hour meters for motors. The control panel will be UL 508 approved as an assembly. All wiring consistent with standards set forth in the NEC.

Exhaust Stack

The stack for the discharge of cleaned gases is self supporting and made of stainless steel. The stack will terminate at 15' AGL and is supplied with sampling ports.

Painting

The entire unit will be cleaned and painted with two part epoxy paint for corrosion free long life.

Structural

The entire oxidizer assembly is mounted on an ASTM trussed structural steel base suitable for forklift or crane.

Tertiary & Combustion Air Fan

The fan is a centrifugal type and is sized to process the maximum air throughput with minimal resistance to air-flow. The fan is direct drive.

Automatic Purge Control

The oxidizer must be purged with fresh air prior to the introduction of contaminated vapors per NFPA 86. To accomplish this, the combustion air blower is enabled for a specified time. Once complete, the system will enable the pre-heat mode.

Temperature Control

Combustion chamber temperature is continuously monitored via thermocouple. The thermocouple and digital indicating temperature controller enable a 4-20ma PID loop with the variable frequency tertiary air fan to maintain the combustion chamber set-point temperature.